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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/665,982

09/18/2003

Henry F. Erk

MEMC 02-0051 (3032.1)

5374

321

7590

05/30/2006

SENNIGER POWERS  
ONE METROPOLITAN SQUARE  
16TH FLOOR  
ST LOUIS, MO 63102

EXAMINER

CHEN, ERIC BRICE

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 05/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/665,982

Applicant(s)

ERK ET AL.

Examiner

Eric B. Chen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 11 May 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-99 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-99 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Withdrawal of Finality***

1. To further address Applicants' arguments in the After Final Response, filed May 11, 2006, the finality of that action is withdrawn.

### ***Allowable Subject Matter***

2. The indicated allowability of claims 7-16, 22, 33-81, 88 and 90 are withdrawn in view of the reference to Ionue, Fruitman, Wolf, and Kuramochi. Rejections based on the newly cited references follow.

### ***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-22, 26-28, 33-78, 82-87, 89, and 91-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue et al. (U.S. Patent Appl. Pub. No. 2001/0003672).

5. As to claim 1, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of

an aqueous solution comprising water and a source of hydroxide ions (paragraphs 0015, 0023).

6. Ionue does not expressly disclose that the concentration of water in the caustic etchant being less than 45% by weight in a single embodiment. However, Ionue discloses that the concentration of alkali metal hydroxide is up to 30% by weight (paragraph 030). Moreover, Ionue teaches that as the amount of the alkali metal hydroxide is increased, the polishing removal rate also increases (“[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...,” paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Thus, one who is skilled in the art who desires a higher polishing removal rate would use a of alkali metal hydroxide of about 30% by weight, the higher end of Ionue’s disclosed range (paragraph 030). It should further be noted that Ionue’s disclose of an alkali metal hydroxide up to 30% by weight is not limited by the preferred embodiments (“it should be understood that the present invention is by no means restricted to such specific Examples”) (paragraph 0062).

7. Additionally, Ionue discloses that the concentration of abrasive is up to 50% by weight (paragraph 049). Ionue further teaches that the concentration of abrasive is related to the polishing removal rate (“[i]f the content of the abrasive is too small, the polishing removal rate will be low... On the other hand, if it is too large, uniform dispersion tends to be hardly maintained, paragraph 0049). Thus, one who is skilled in the art who desires a higher polishing removal rate would use a concentration of

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abrasive of about 50% by weight (paragraph 049), the higher end of Ionue's disclosed range. It should further be noted that Ionue's disclose of a concentration of abrasive of up to 50% by weight is not limited by the preferred embodiments ("it should be understood that the present invention is by no means restricted to such specific Examples") (paragraph 0062).

8. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration of abrasive up to 50% by weight and a concentration of alkali metal hydroxide up to 30% by weight. As a result, the concentration of water can be as low as 20% by weight, (or a concentration of water being less than 45% by weight). One who is skilled in the art would be motivated to increase the polishing rate of the wafer.

9. As to claim 2, Ionue suggests that the concentration of water in the caustic etchant is at least about 10% by weight, as discussed in the rejection of claim 1.

10. As to claim 3, Ionue suggests that the concentration of water in the caustic etchant is at least about 20% by weight, as discussed in the rejection of claim 1.

11. As to claim 4, Ionue suggests that the concentration of water in the caustic etchant is at least about 25% by weight, as discussed in the rejection of claim 1.

12. As to claim 5, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 42% by weight, as discussed in the rejection of claim 1.

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13. As to claim 6, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 37% by weight, as discussed in the rejection of claim 1.

14. As to claim 7, Ionue does not expressly disclose that the concentration of the source of hydroxide ions in the caustic etchant is greater than 55% by weight.

However, Ionue teaches that as the amount of the alkali metal hydroxide is increased, the polishing removal rate also increases (“[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...,” paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Moreover, Ionue teaches, by disclosing that the alkali metal hydroxide concentration may be varied, that changing the concentration appears to reflect a result-effective variable which can be optimized. See MPEP § 2144.05 (II)(B). Alkali metal hydroxide concentration can be varied accordingly, depending on the desired outcome of the polishing step, such as a high polishing removal rate.

Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight. One who is skilled in the art would be motivated to optimize polishing removal rate through routine experimentation of alkali metal hydroxide concentrations. See MPEP § 2144.05 (II)(B).

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15. As to claim 8, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is at least about 58% by weight, as discussed in the rejection of claim 7.

16. As to claim 9, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is at least about 58% by weight, as discussed in the rejection of claim 7.

17. As to claim 10, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is at least about 62% by weight, as discussed in the rejection of claim 7.

18. As to claim 11, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is at least about 65% by weight, as discussed in the rejection of claim 7.

19. As to claim 12, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is no more than about 75% by weight, as discussed in the rejection of claim 7.

20. As to claim 13, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is from about 58% to about 70% by weight, as discussed in the rejection of claim 7.

21. As to claim 14, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is from about 58% to about 65% by weight, as discussed in the rejection of claim 7.

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22. As to claim 15, Ionue suggests that the alkali metal hydroxide the concentration of the source of hydroxide ions in the caustic etchant is from about 62% to about 65% by weight, as discussed in the rejection of claim 7.

23. As to claim 16, Ionue discloses that the source of hydroxide ions comprises an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide (paragraph 0023).

24. As to claim 17, Ionue discloses that the caustic etchant further comprises a salt additive (paragraphs 0015, 0024).

25. As to claim 18, Ionue discloses that the salt additive is selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraphs 0015, 0024).

26. As to claim 19, Ionue discloses that the salt additive comprises a compound selected from the group consisting of potassium fluoride and potassium carbonate (paragraph 0024).

27. As to claim 20, Ionue discloses that the concentration of the salt additive ("alkali metal...carbonate") in the caustic etchant is no more than about 25% by weight (paragraphs 0031, 0024).

28. As to claim 21, Ionue discloses that the concentration of the salt additive ("alkali metal...carbonate") in the caustic etchant is from about 5% to about 25% by weight (paragraphs 0031, 0024).

29. As to claim 22, Ionue does not expressly discloses that the concentration of the source of hydroxide ions in the caustic etchant is greater than 55% by weight.



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However, Ionue teaches that as the amount of the alkali metal hydroxide (or hydroxide ions) is increased, the polishing removal rate also increases ("[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...", paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Moreover, Ionue teaches, by disclosing that the alkali metal hydroxide (or hydroxide ions) concentration may be varied, that changing the concentration appears to reflect a result-effective variable which can be optimized. See MPEP § 2144.05 (II)(B). Alkali metal hydroxide concentration can be varied accordingly, depending on the desired outcome of the polishing step, such as a high polishing removal rate. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight. One who is skilled in the art would be motivated to optimize polishing removal rate through routine experimentation of alkali metal hydroxide concentrations. See MPEP § 2144.05 (II)(B).

30. As to claim 26, Ionue does not expressly disclose that the surface of the wafer is contacted with the caustic etchant by immersing the wafer in the caustic etchant. However, Ionue discloses a chemical mechanical polishing of the wafers with the caustic etchant (paragraphs 0067-0075). Thus, the surface of the wafer is inherently contacted with the caustic etchant by immersing the wafer in the caustic etchant during

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chemical mechanical polishing. See Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002) ("Wolf IV"), pages 322-324.

31. As to claim 27, Ionue discloses that the wafer is rotated while immersed in the caustic etchant (paragraph 0071).

32. As to claim 28, Ionue discloses that the rate of rotation of the wafer immersed in the caustic etchant is from about 1 revolution per minute to about 100 revolutions per minute (paragraph 0071).

33. As to claim 33, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer, the process comprising contacting the surface of the silicon wafer with a caustic etchant in the form of an aqueous solution comprising water and a source of hydroxide ions (paragraph 0015, 0021, 0023).

34. Ionue does not expressly disclose that the concentration of the source of hydroxide ions in the caustic etchant being greater than 55% by weight. However, Ionue teaches that as the amount of the alkali metal hydroxide (or hydroxide ions) is increased, the polishing removal rate also increases ("[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...", paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Moreover, Ionue teaches, by disclosing that the alkali metal hydroxide (or hydroxide ions) concentration may be varied, that changing the concentration appears to reflect a result-effective variable which can be optimized. See MPEP § 2144.05 (II)(B). Alkali metal hydroxide concentration can be varied

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accordingly, depending on the desired outcome of the polishing step, such as a high polishing removal rate. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration of the source of hydroxide ions in the caustic etchant greater than 55% by weight. One who is skilled in the art would be motivated to optimize polishing removal rate through routine experimentation of alkali metal hydroxide concentrations. See MPEP § 2144.05 (II)(B).

35. As to claim 34, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is at least about 58% by weight, as discussed in the rejection of claim 33.

36. As to claim 35, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is at least about 60% by weight, as discussed in the rejection of claim 33.

37. As to claim 36, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is at least about 62% by weight, as discussed in the rejection of claim 33.

38. As to claim 37, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is at least about 65% by weight, as discussed in the rejection of claim 33.

39. As to claim 38, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is no more than about 75% by weight, as discussed in the rejection of claim 33.

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40. As to claim 39, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is from about 58% to about 70% by weight, as discussed in the rejection of claim 33.

41. As to claim 40, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is from about 58% to about 65% by weight, as discussed in the rejection of claim 33.

42. As to claim 41, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is from about 62% to about 65% by weight, as discussed in the rejection of claim 33.

43. As to claim 42, Ionue discloses that the source of hydroxide ions comprises an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide (paragraph 0023).

44. As to claim 43, Ionue discloses that the source of hydroxide ions comprises sodium hydroxide (paragraph 0023).

45. As to claim 44, Ionue suggests that the concentration of sodium hydroxide in the caustic etchant is at least about 58% by weight, as discussed in the rejection of claim 33.

46. As to claim 45, Ionue suggests that the concentration of sodium hydroxide in the caustic etchant is at least about 62% by weight, as discussed in the rejection of claim 33.

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47. As to claim 46, Ionue suggests that the concentration of sodium hydroxide in the caustic etchant is no more than about 68% by weight, as discussed in the rejection of claim 33.

48. As to claim 47, Ionue suggests that the concentration in the caustic etchant is from about 58% to about 68% by weight, as discussed in the rejection of claim 33.

49. As to claim 48, Ionue suggests that the concentration of sodium hydroxide in the caustic etchant is from about 61% to about 63% weight, as discussed in the rejection of claim 33.

50. As to claim 49, Ionue suggests that the concentration of sodium hydroxide in the caustic etchant is from about 61% to about 63% weight, as discussed in the rejection of claim 33.

51. As to claim 50, Ionue discloses that the source of hydroxide ions comprises potassium hydroxide (paragraph 0023).

52. As to claim 51, Ionue suggests that the concentration of potassium hydroxide in the caustic etchant is at least about 57% by weight, as discussed in the rejection of claim 33.

53. As to claim 52, Ionue suggests that the concentration of potassium hydroxide in the caustic etchant is at least about 60% by weight, as discussed in the rejection of claim 33.

54. As to claim 53, Ionue suggests that the concentration of potassium hydroxide in the caustic etchant is no more than about 63% by weight, as discussed in the rejection of claim 33.

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55. As to claim 54, Ionue suggests that the concentration of potassium hydroxide in the caustic etchant is from about 57% to about 63% by weight, as discussed in the rejection of claim 33.

56. As to claim 55, Ionue suggests that the concentration of potassium hydroxide in the caustic etchant is from about 60% to about 63% by weight, as discussed in the rejection of claim 33.

57. As to claim 56, Ionue suggests that concentration of water in the caustic etchant is at least about 20% by weight, as discussed in the rejection of claim 1.

58. As to claim 57, Ionue suggests that the concentration of water in the caustic etchant is at least about 25% by weight, as discussed in the rejection of claim 1.

59. As to claim 58, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 42% by weight, as discussed in the rejection of claim 1.

60. As to claim 59, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 37% by weight, as discussed in the rejection of claim 1.

61. As to claim 60, Ionue discloses that the caustic etchant further comprises a salt additive, the salt additive comprising a compound selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraphs 0015, 0024).

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62. As to claim 61, Ionue discloses that the concentration of salt additive ("alkali metal...carbonate") in the caustic etchant is no more than about 25% by weight (paragraphs 0031, 0024).

63. As to claim 62, Ionue discloses that the concentration of salt additive ("alkali metal...carbonate") in the caustic etchant is from about 5% to about 25% by weight (paragraphs 0031, 0024).

64. As to claim 63, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer, the process comprising contacting the surface of the silicon wafer with a caustic etchant in the form of an aqueous solution comprising water and a source of hydroxide ions (paragraph 0015, 0021, 0023).

65. Ionue does not expressly disclose that the concentration of the source of hydroxide ions in the caustic etchant being at least about 70% of the saturation concentration of the source of hydroxide ions in the caustic etchant. However, Ionue teaches that as the amount of the alkali metal hydroxide (or hydroxide ions) is increased, the polishing removal rate also increases ("[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...", paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Moreover, Ionue teaches, by disclosing that the alkali metal hydroxide (or hydroxide ions) concentration may be varied, that changing the concentration appears to reflect a result-effective variable which can be optimized. See MPEP § 2144.05 (II)(B). Alkali metal hydroxide concentration can be varied

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accordingly, depending on the desired outcome of the polishing step, such as a high polishing removal rate. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration of the source of hydroxide ions in the caustic etchant being at least about 70% of the saturation concentration of the source of hydroxide ions in the caustic etchant. One who is skilled in the art would be motivated to optimize polishing removal rate through routine experimentation of alkali metal hydroxide concentrations. See MPEP § 2144.05 (II)(B).

66. As to claim 64, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is at least about 74% of the saturation concentration of the source of hydroxide ions in the caustic etchant, as discussed in the rejection of claim 63.

67. As to claim 65, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is less than about 95% of the saturation concentration of the source of hydroxide ions in the caustic etchant, as discussed in the rejection of claim 63.

68. As to claim 66, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is less than about 95% of the saturation concentration of the source of hydroxide ions in the caustic etchant, as discussed in the rejection of claim 63.

69. As to claim 67, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is from about 74% to about 90% of the saturation



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concentration of the source of hydroxide ions in the caustic etchant, as discussed in the rejection of claim 63.

70. As to claim 68, Ionue suggests that the concentration of the source of hydroxide ions in the caustic etchant is from about 74% to about 81% of the saturation concentration of the source of hydroxide ions in the caustic etchant, as discussed in the rejection of claim 63.

71. As to claim 69, Ionue discloses that the source of hydroxide ions comprises an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide (paragraph 0023).

72. As to claim 70, Ionue discloses that the source of hydroxide ions comprises sodium hydroxide (paragraph 0023).

73. As to claim 71, Ionue discloses that the source of hydroxide ions comprises potassium hydroxide (paragraph 0023).

74. As to claim 72, Ionue discloses that the caustic etchant further comprises a salt additive, the salt additive comprising a compound selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraphs 0015, 0024).

75. As to claim 73, Ionue discloses that the concentration of salt additive ("alkali metal...carbonate") in the caustic etchant is no more than about 25% by weight (paragraphs 0031, 0024).

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76. As to claim 74, Ionue discloses that the concentration of salt additive ("alkali metal...carbonate") in the caustic etchant is from about 5% to about 25% by weight (paragraphs 0031, 0024).

77. As to claim 75, Ionue suggests that concentration of water in the caustic etchant is at least about 20% by weight, as discussed in the rejection of claim 1.

78. As to claim 76, Ionue suggests that the concentration of water in the caustic etchant is at least about 25% by weight, as discussed in the rejection of claim 1.

79. As to claim 77, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 42% by weight, as discussed in the rejection of claim 1.

80. As to claim 78, Ionue suggests that the concentration of water in the caustic etchant is from about 30% to about 37% by weight, as discussed in the rejection of claim 1.

81. As to claim 82, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of an aqueous solution comprising water, hydroxide ions, and a salt additive (paragraphs 0015, 0024), the salt additive comprising a compound selected from the group consisting of inorganic alkali and alkaline earth metal salts and mixtures thereof (paragraph 0024).

82. Ionue does not expressly disclose that the concentration of the salt additive in the caustic etchant being at least about 4 mole percent in a single embodiment.

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However, Ionue discloses that the concentration of alkali metal hydroxide is up to 30% by weight. Moreover, Ionue teaches that as the amount of the alkali metal hydroxide is increased, the polishing removal rate also increases (“[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...,” paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Thus, one who is skilled in the art who desires a higher polishing removal rate would use a of alkali metal hydroxide of about 30% by weight, the higher end of Ionue’s disclosed range (paragraph 030). It should further be noted that Ionue’s disclose of an alkali metal hydroxide up to 30% by weight is not limited by the preferred embodiments (“it should be understood that the present invention is by no means restricted to such specific Examples”) (paragraph 0062).

83. Additionally, Ionue discloses that the concentration of salt additive (paragraph 0023) is up to 30 weight percent (paragraph 0031). Ionue teaches that the additive functions to accelerate the polishing by chemical action (paragraph 0021). Moreover, Ionue teaches, by disclosing that the salt additive concentration may be varied, that changing the concentration appears to reflect a result-effective variable which can be optimized. See MPEP § 2144.05 (II)(B). Salt additive concentration can be varied accordingly, depending on the desired outcome of the polishing step, to achieve the desired amount of polish acceleration through chemical action. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration of salt additive up to 30

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weight percent. One who is skilled in the art would be motivated to optimize polish acceleration through chemical action through routine experimentation of salt additive concentrations. See MPEP § 2144.05 (II)(B).

84. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration mixture of about 50% by weight water (molar mass = 18 g/mole), about 30% by weight sodium hydroxide (molar mass = 40 g/mole), and about 20% by weight potassium carbonate (molar mass = 138 g/mole). In other words, there is a suggestion that both the concentration of sodium hydroxide and potassium carbonate are results-effective variables. This mixture yields a water concentration of about 75 mole percent, a sodium hydroxide concentration of about 20 mole percent, and a potassium carbonate concentration of about 5 mole percent.

85. Ionue does not expressly disclose that the salt additive does not decompose or react in the caustic etchant. However, because Applicant's caustic etchant contains the same components as Ionue's etchant (paragraphs 0015, 0023, 0024), one who is skilled in the art would expect the salt additive does not decompose or react in the caustic etchant.

86. As to claim 83, Ionue suggests that the concentration of the salt additive in the caustic etchant is at least about 5 mole percent, as discussed in the rejection of claim

82. A mixture of 50% by weight water, a small amount of sodium hydroxide, and about 50% by weight potassium carbonate yields a potassium carbonate concentration of about 11 mole percent.

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87. As to claim 84, Ionue suggests that the concentration of the salt additive in the caustic etchant is at least about 10 mole percent, as discussed in the rejection of claim 83.

88. As to claim 85, Ionue suggests that the concentration of the salt additive in the caustic etchant is from about 4 to about 15 mole percent, as discussed in the rejection of claim 82.

89. As to claim 86, Ionue discloses that the salt additive comprises an inorganic sodium or potassium salt (paragraph 0024).

90. As to claim 87, Ionue discloses that the salt additive comprises an inorganic salt selected from the group consisting of potassium carbonate (paragraph 0024) and sodium carbonate (paragraph 0024).

91. As to claim 89, Ionue discloses that the salt additive comprises potassium carbonate (paragraph 0024).

92. As to claim 91, Ionue suggests that the concentration of hydroxide ions in the caustic etchant is no more than about 20 mole percent, as discussed in the rejection of claim 82.

93. As to claim 92, Ionue suggests that the concentration of hydroxide ions in the caustic etchant is no more than about 15 mole percent, as discussed in the rejection of claim 82.

94. As to claim 93, Ionue suggests that the concentration of hydroxide ions is from about 10 to about 15 mole percent, as discussed in the rejection of claim 82.

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95. As to claim 94, Ionue suggests that the concentration of water in the caustic etchant is no more than about 85 mole percent, as discussed in the rejection of claim 82.

96. As to claim 95, Ionue suggests that the concentration of water in the caustic etchant is from about 70 to about 85 mole percent, as discussed in the rejection of claim 82.

97. As to claim 96, Ionue suggests that the concentration of water in the caustic etchant is from about 75 to about 85 mole percent, as discussed in the rejection of claim 82.

98. As to claim 97, Ionue does not expressly disclose that the pH of the caustic etchant is at least about 13. However, the pH of sodium hydroxide solutions is inherently greater than 12. See ClearTech Technical Department, ClearTech Industries, Sodium Hydroxide Solutions MSDS (2001).

99. As to claim 98, Ionue does not expressly disclose that the pH of the caustic etchant is from about 13.9 to about 14. However, the pH of sodium hydroxide solutions is inherently greater than 12. See ClearTech Technical Department, ClearTech Industries, Sodium Hydroxide Solutions MSDS (2001).

100. As to claim 99, Ionue discloses an etching process for removing silicon from the surface of a silicon wafer (paragraph 0015), the process comprising contacting the surface of the silicon wafer with a caustic etchant (paragraphs 0069-0075) in the form of an aqueous solution comprising water, hydroxide ions, and a salt additive (paragraphs

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0015, 0024) the salt additive comprising a compound selected from the group consisting of potassium carbonate and potassium fluoride (paragraph 0024).

101. Ionue does not expressly disclose that the concentration of the salt additive in the caustic etchant being at least about 4 mole percent in a single embodiment. However, Ionue discloses that the concentration of alkali metal hydroxide is up to 30% by weight. Moreover, Ionue teaches that as the amount of the alkali metal hydroxide is increased, the polishing removal rate also increases (“[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...,” paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is increased, polishing removal rate also increases, paragraph 0081). Thus, one who is skilled in the art who desires a higher polishing removal rate would use a of alkali metal hydroxide of about 30% by weight (or a sodium hydroxide concentration of about 20 mole percent), the higher end of Ionue’s disclosed range (paragraph 030). It should further be noted that Ionue’s disclose of an alkali metal hydroxide up to 30% by weight is not limited by the preferred embodiments (“it should be understood that the present invention is by no means restricted to such specific Examples”) (paragraph 0062).

102. Additionally, Ionue discloses that the concentration of potassium carbonate (paragraph 0023) is up to 30 weight percent (paragraph 0031). Ionue teaches that the additive functions to accelerate the polishing by chemical action (paragraph 0021). Moreover, Ionue teaches, by disclosing that the potassium carbonate concentration may be varied, that changing the concentration appears to reflect a result-effective variable

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which can be optimized. See MPEP § 2144.05 (II)(B). Potassium carbonate concentration can be varied accordingly, depending on the desired outcome of the polishing step, to achieve the desired amount of polish acceleration through chemical action. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration of potassium carbonate up to 30 weight percent. One who is skilled in the art would be motivated to optimize polish acceleration through chemical action through routine experimentation of potassium carbonate concentrations. See MPEP § 2144.05 (II)(B).

103. Therefore, in the absence of unexpected results, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a concentration mixture of about 50% by weight water (molar mass = 18 g/mole), about 30% by weight sodium hydroxide (molar mass = 40 g/mole), and about 20% by weight potassium carbonate (molar mass = 138 g/mole). In other words, there is a suggestion that both the concentration of sodium hydroxide and potassium carbonate are results-effective variables. This mixture yields a water concentration of about 75 mole percent, a sodium hydroxide concentration of about 20 mole percent, and a potassium carbonate concentration of about 5 mole percent.

104. Ionue does not expressly disclose that the salt additive does not decompose or react in the caustic etchant. However, because Applicant's caustic etchant contains the same components as Ionue's etchant (paragraphs 0015, 0023, 0024), one who is skilled in the art would expect the salt additive does not decompose or react in the caustic etchant.



***Claim Rejections - 35 USC § 103***

105. Claims 23-25, 29, and 79-81 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Netsu (U.S. Patent No. 6,099,748).

106. As to claims 23 and 79, Ionue does not expressly disclose that the temperature of the caustic etchant contacted with the silicon wafer is at least about 70°C. However, Netsu discloses a method of etching a silicon wafer, including using a temperature of the caustic etchant (column 2, line 40) contacted with the silicon wafer that is at least about 70°C (column 2, lines 48-49). Netsu further teaches that etching with the caustic etchant at a temperature range of 65°C to 85°C results in an appropriate etching rate. Moreover, too low of an etching rate impairs productivity, whereas too high of an etching rate results in adverse surface effects (column 2, lines 50-54).

107. As to claims 24 and 80, Netsu discloses that the temperature of the caustic etchant contacted with the silicon wafer is from about 65°C to 85°C (column 2, lines 48-49). It should be noted that there is overlap between the Applicants' claimed temperature range and Netsu's temperature range. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a temperature of the caustic etchant contacted with the silicon wafer from about 70°C to 120°C. One who is skilled in the art would be motivated to use a temperature range that overlaps with a temperature range known to produce desirable silicon etching rates.

108. As to claims 25 and 81, Netsu discloses that the temperature of the caustic etchant contacted with the silicon wafer is from about 75°C to 85°C (column 2, lines 48-49).

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109. As to claim 29, Ionue does not expressly disclose that the wafer is immersed in the caustic etchant for a time such that the amount of silicon removed from the surface of the wafer is from about 10  $\mu\text{m}$  to about 30  $\mu\text{m}$  in terms of total thickness from both the front and back surface of the wafer. However, Netsu discloses a method of etching a silicon wafer, including immersing the wafer in the caustic etchant (column 2, line 40) for a time such that the amount of silicon removed from the surface of the wafer is from about 10  $\mu\text{m}$  to about 30  $\mu\text{m}$  in terms of total thickness from both the front and back surface of the wafer (column 2, lines 59-62). Moreover, Netsu teaches that removal of a thickness in this range is required to eliminate mechanical damage (column 2, lines 63-67) introduced by mechanically slicing the wafer (column 1, lines 15-25). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to immerse the wafer in the caustic etchant for a time such that the amount of silicon removed from the surface of the wafer is from about 10  $\mu\text{m}$  to about 30  $\mu\text{m}$  in terms of total thickness from both the front and back surface of the wafer. One who is skilled in the art would be motivated to eliminate mechanical damage from the wafer.

***Claim Rejections - 35 USC § 103***

110. Claims 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Tsung-Kuei et al. (U.S. Patent No. 6,793,836).

111. As to claim 30, Ionue does not expressly disclose that the surface of the wafer is contacted with the caustic etchant by spraying the surface of the wafer with the caustic etchant. However, Tsung-Kuei discloses a method of wet etching, including spraying

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the surface of the wafer with etchant (column 1, lines 47-55; column 2, lines 55-57; Figure 1). Tsung-Kuei teaches that spray and spin etching is a commonly used wet etching technique for silicon (column 1, lines 13-18) that provides for more uniform etching (column 1, lines 35-36). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to contact the surface of the wafer with the caustic etchant by spraying the surface of the wafer with the caustic etchant. One who is skilled in the art would be motivated to use a commonly used wet etching technique for silicon that provides for more uniform etching.

112. As to claim 31, Tsung-Kuei discloses that the wafer is rotated while the surface of the wafer is sprayed with the etchant (column 1, lines 47-55).

113. As to claim 32, Tsung-Kuei discloses that the rate of rotation of the wafer is from about 50 revolutions per minute to about 650 revolutions per minute (column 2, lines 9-16).

### ***Claim Rejections - 35 USC § 103***

114. Claim 88 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Fruitman (U.S. Patent No. 5,769,691), in further view of Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002).

115. As to claim 88, Ionue does not expressly disclose that the salt additive comprises potassium fluoride. However, Fruitman discloses an etching process, including an abrasive slurry containing potassium fluoride as a suitable additive for oxidation purposes (column 3, lines 42-62). Wolf teaches that when polishing bare silicon wafers,

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the silicon surface must first be oxidized prior to the mechanical removal of the oxide (page 336). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include potassium fluoride. One who is skilled in the art would be motivated to use a suitable etching additive for oxidation purposes.

### ***Claim Rejections - 35 USC § 103***

116. Claim 90 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ionue, in view of Fruitman (U.S. Patent No. 5,769,691), in view of Kuramochi et al. (U.S. Patent No. 6,361,403).

117. As to claim 90, Ionue does not expressly disclose that the salt additive comprises an inorganic alkali metal or alkaline earth metal salt hydrate. However, Kuramochi discloses polishing process, including an abrasive slurry containing alkali metal salt hydrides (column 4, lines 38-48). Kuramochi further teaches that the additives, including alkali metal salt hydrides, function to enhance the rate of polishing (column 4, lines 62-65). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made include an inorganic alkali metal hydrate. One who is skilled in the art would be motivated to enhance the rate of polishing.

### ***Response to Arguments***

118. Applicants' arguments (Applicants' Remarks, pages 3-6), filed May 11, 2006, with respect to the rejection of claims 1-6, 17-21 and 26-28 under 35 U.S.C. 102(b) as being anticipated by Ionue have been fully considered and are persuasive. Therefore, the

rejection has been withdrawn. However, upon further consideration, a new grounds of rejection is made in view of Ionue under 35 U.S.C. 103(a).

119. Applicants' arguments (Applicants' Remarks, pages 6-7), filed May 11, 2006, with respect to the rejection of claims 23-25 and 29-32 under 35 U.S.C. 103(a) have been considered but are moot in view of the new grounds of rejection.

120. Applicants' arguments (Applicants' Remarks, pages 7-10), filed May 11, 2006, with respect to the rejection of claims 23-25 and 29-32 under 35 U.S.C. 103(a) as being anticipated by Ionue have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new grounds of rejection is made in view of Ionue.

121. Applicants' arguments (Applicants' Remarks, pages 10-11), filed May 11, 2006, regarding the previous allowance of claims 33-81 (currently withdrawn), have been fully considered but they are not persuasive. Netsu teaches that when the concentration of alkali component exceeds 55 weight percent, the component precipitates out of the bath (column 4, lines 15-21). However, Netsu only teaches a maximum solution temperature of 85°C (column 4, lines 45-46). In general, increasing the temperature of the solution also increases the solubility limit. See Callister, *Materials Science and Engineering*, 4th ed., John Wiley & Sons (1997), pages 237-38. Ionue teaches that as the amount of the alkali metal hydroxide is increased, the polishing removal rate also increases ("[w]hen such an additive is used for a polishing composition, there is a tendency that as the amount increases, the polishing removal rate becomes high...", paragraph 0032; TABLE 1, Ex. 1 to Ex. 6 demonstrates that when KOH/NaOH concentration is

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increased, polishing removal rate also increases, paragraph 0081). Thus, motivation exists to increase the concentration of alkali metal hydroxide to obtain the desired polishing removal rate. Moreover, one who is skilled in the art would increase the temperature of the etching solution to obtain the appropriate solubility limit.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

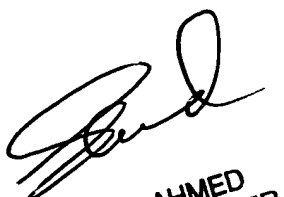
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EBC

May 22, 2006

EBC

  
SHAMIM AHMED  
PRIMARY EXAMINER